KNOWLEDGE

FLEXIBILITY OF MODERN RADIANT CEILING SYSTEMS

Unbeatable adaptability

BARCOL-AIR
by Swegon

Feel good inside

Introduction

Over recent decades, radiant ceilings have become a standard solution for room air conditioning. These water based multifunctional systems, also known as radiant heating ceilings or chilled ceilings, can be found in office buildings and salesrooms, as well as in factory buildings and healthcare facilities.

At the same time, the demands placed on the sustainability of building technology equipment are constantly increasing. The topics of capacity and energy efficiency of radiant ceilings have already been discussed in the other informative documents “Capacity-boosting factors” and “Energy efficient cooling”. But what about the “grey energy” tied up in the products? And how can we prevent even the smallest changes to the room design resulting in major costs for new radiant ceiling panels?

This document addresses the following questions:

- Where is grey energy tied up in radiant ceilings?
- Where are new panels required when converting conventional ceilings?
- Which radiant ceiling systems can be used to increase flexibility?

Flexibility of modern radiant ceiling systems

Unbeatable adaptability

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Climate ceiling systems

Grey energy – what is it?

Previous product energy balance analyses only took into consideration the energy consumed during operation of the product. However, processes such as the manufacture, transport and disposal of a product clearly also use energy.

The energy that has to be expended before and after the products are used is known as "grey energy", although another phrase commonly used – "embodied energy" – is probably more accurate.

Perhaps the most obvious factor that springs to mind here is the transport of products from the factory to the customer. The further away the factory, and the faster the product has to be transported (e.g. by air), the higher the energy consumption.

However, a much larger proportion of grey energy is used in the production of raw materials. The following table is only intended to provide a rough overview. The proportion of recycling, the origin and the manufacturing processes have a significant influence here:

Material, [per 1 kg]	Primary energy [MJ]	CO_2 equivalent [kg]
Aluminium	200	16
Copper	150	12
Sheet steel	50	4
Mineral wool	10 – 20	1 – 2
Plasterboard panel	5	0.5

In all these examples, the energy costs correlate with the financial costs.

Grey energy in modern radiant ceiling systems

Radiant ceiling systems must satisfy various requirements. Essentially, these are:

- Durability/installation of fixtures (lighting, smoke detectors, etc.)
- Safety (fire protection and resistance, earthquake safety, fall protection)
- Transport of cooling and heating energy
- Sound absorption
- Aesthetics (jointless with plaster, metal ceilings, baffles, etc.)
- Hygiene
- Keeping production and installation costs as low as possible

In a development process lasting around three decades, the materials have been tailored to meet the requirements listed above. The following materials in particular have made the grade:

- Galvanised sheet steel -> durable, easy to machine, relatively high thermal conductivity
- Aluminium -> very high thermal conductivity, easy to machine
- Copper -> very high thermal conductivity, barely corrodes
- Plasterboard -> simple and flexible processing, high fire resistance
- Mineral wool -> sound absorption, non-combustible, inexpensive

Until now, the energy required to produce these raw materials has only been relevant in terms of costs – although energy costs were extremely low until very recently. Although price increases for energy were significant in the 2020s, they have not yet reached an "unbearable" level.

Alongside the pure costs, however, the demands placed on product sustainability are now increasing. Over the next few years, this will certainly lead to a change in the materials used. However, the focus of this document should remain on preventing the need for new purchases in the first place through a high degree of flexibility.

Additional investment for office conversions with conventional systems

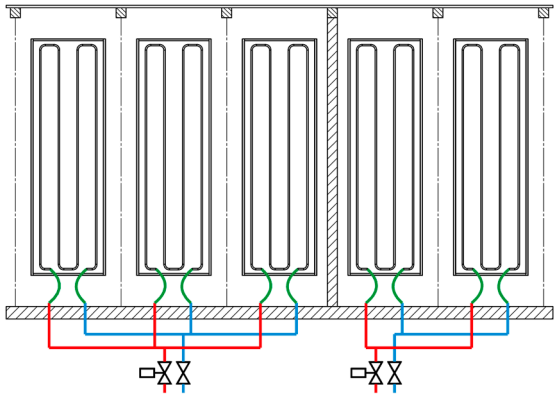
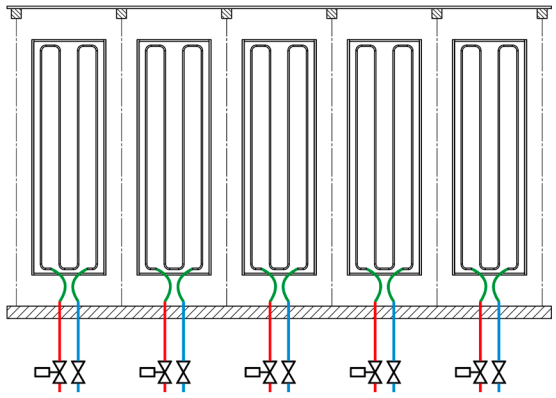
Modern office environments are extremely flexible zones that have to fulfil the requirements of a wide variety of users and forms of use. For example, a building may be designed primarily with open-plan offices. However, after a few years, the original tenant moves out and the new tenant wants to install partition walls on every third room axis.

With conventional systems, a significant proportion of the ceilings are often disposed of and reordered, because it is not possible to arrange the existing panels to fit the new room geometry.

The conversion of former group offices into meeting rooms is also common, in which case the air flow rate must be increased by a factor of 2-4 (from approx. 3-6 to 12 $m^3/h*m^2$ floor area). In this case, it is worth opting for flexible supply air diffusers from the outset, in order to save on the costs and energy with new purchases and, in particular, their installation/run-in, etc.

Flexibility of the axis-based hydraulic installation

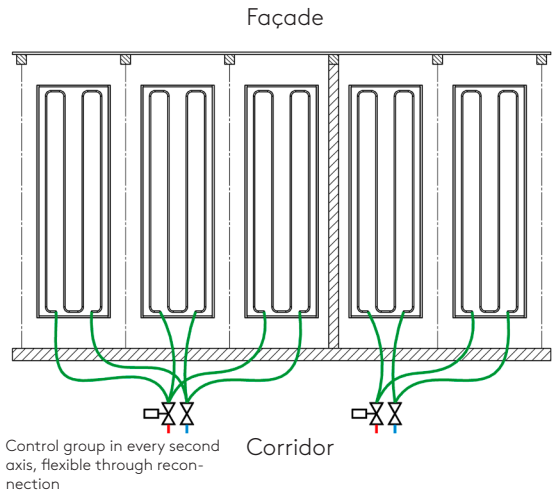
Right from the planning phase, it is essential to consider that the control zones may change due to the subsequent addition or relocation of partition walls. This requires a cost-benefit analysis of different variants. The most important solutions are outlined below:

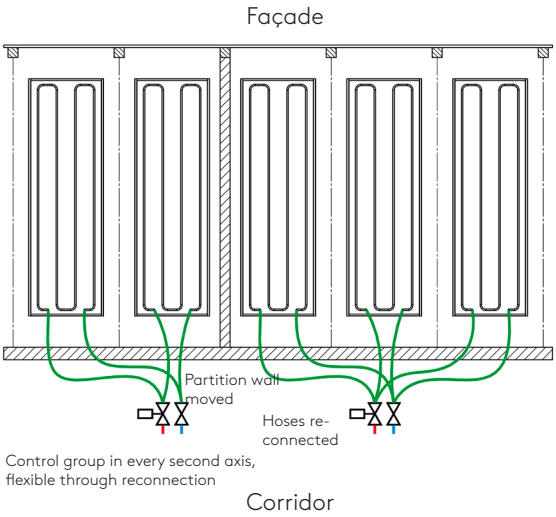
1. Fixed allocation of each room to a control group No flexibility, but most favourable installation If walls are added or moved and the ceiling sails are not assigned to the new zone – which would be relatively time-consuming – there is a risk that dew point monitors will no longer be able to fulfil their function.	Façade  Corridor
2. Standard group in each axis Full flexibility, high installation costs	Façade  Control group in each axis, fully flexible Corridor

3. Control group in every second axis

Flexibility by reconnecting the hoses, moderate installation costs.

Longer hoses; therefore slightly higher pressure loss Here, too, there is a risk that those responsible for the property will fail to reconnect the hoses during subsequent conversions, which means that dew point sensors in particular are no longer correctly assigned.

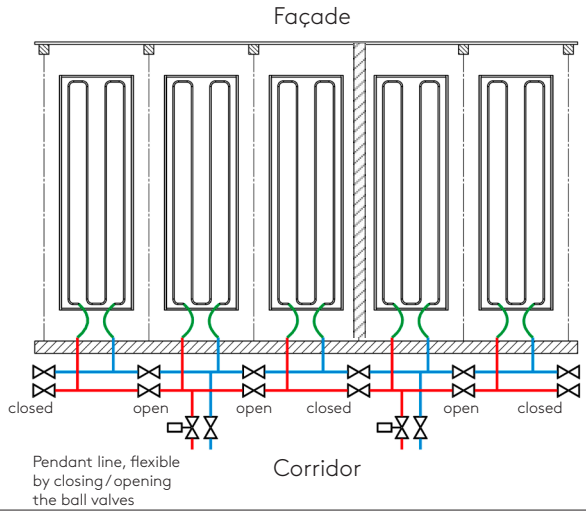




4. Control group in every second axis + pendant line

The “assignment” of the respective axes to the control groups is carried out by opening/closing the ball valves, which means less modification work, but is also very material-intensive and costly.

When implementing such a system, care must be taken to explain how the system works to those responsible for the building (e.g. building services).



Air volume increase or reduction with the CAURUS hybrid system

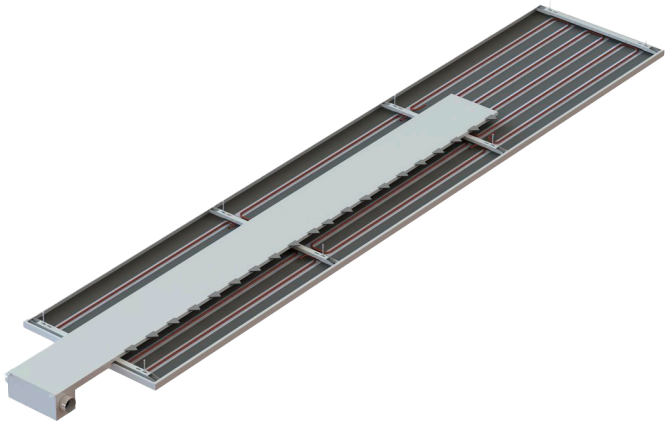
It's a common issue: after a few years, the room layout in an office building is no longer fit for purpose. The meeting room, which was previously located in the centre of the building, is to be moved to the end of the corridor and into a former group office.

This means that the air flow rate in the former office has to be quadrupled from 3 to 12 m³/h*m² floor area. The supply air diffusers initially installed do not deliver this:

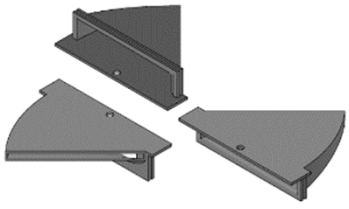
- The pressure loss is too high
- Then, the same applies to the sound power level
- The air speed in the room becomes so high that draughts occur

It is therefore necessary to purchase new supply air diffusers. However, it is not only the diffusers themselves that give rise to costs; first of all they have to be dimensioned, they don't fit into the existing ceiling panels, they need to be installed and run in, and so on.

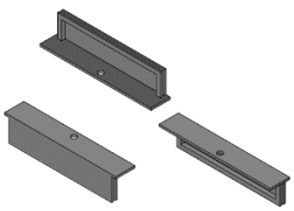
Barcol-Air has developed the CAURUS hybrid system for this purpose. Among its many other advantages, the system offers the option of adding nozzles or replacing them with dummy nozzles at any time. This means that the product can always be set to the optimum air flow.



For very high air flow rates, the system also offers additional nozzles attached to the top of the duct. The caps can be removed with a normal screwdriver, after which the possible air flow is doubled. This requires prior planning of the maximum airflow rates through the nozzle and the duct system.



Nozzles



Dummy nozzles

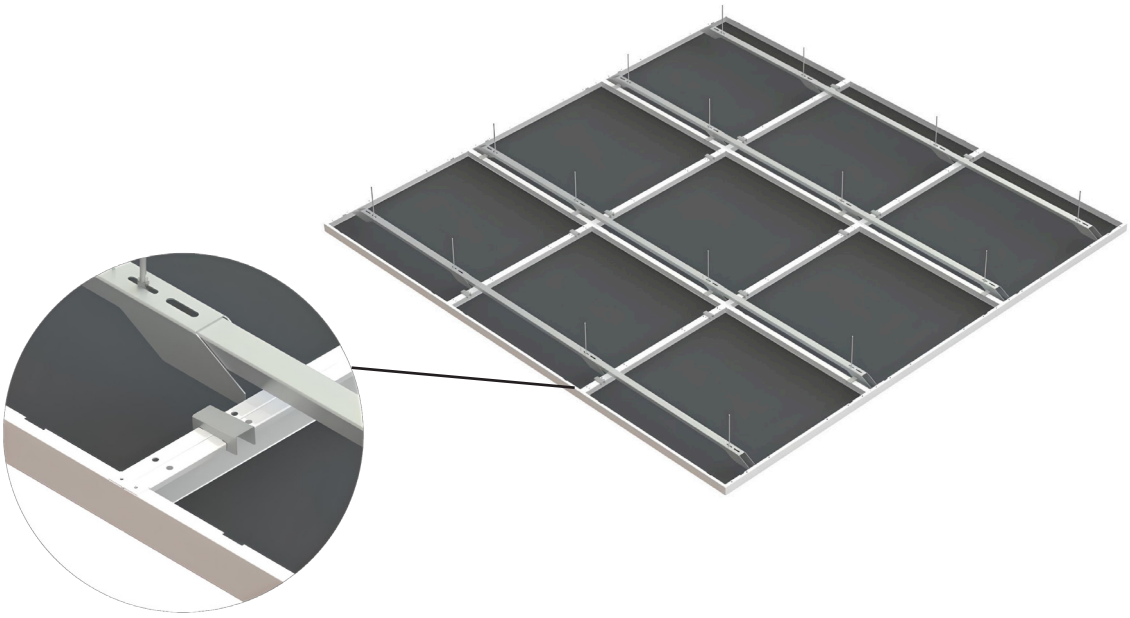
RYKO ceiling sail system for reducing the number of panel types/flexibility for conversions

The RYKO ceiling sail system was originally developed to halve the number of drilling points in a ceiling, but also to create a system that aligns itself without effort and delivers a perfect joint pattern.

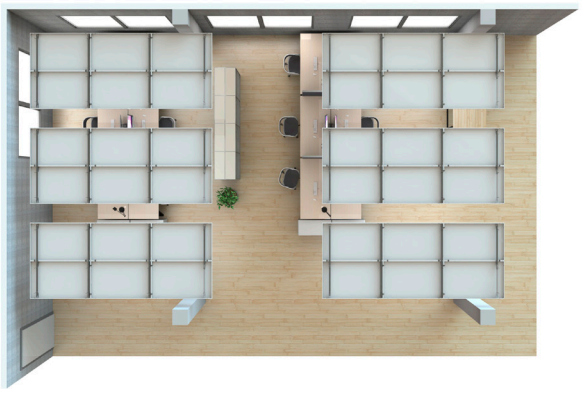
This system has recently been further developed into a highly flexible concept that makes it possible to equip entire buildings with one and the same ceiling panel. This reduces:

- The number of spare panels drastically
- The effort involved in retrofitting

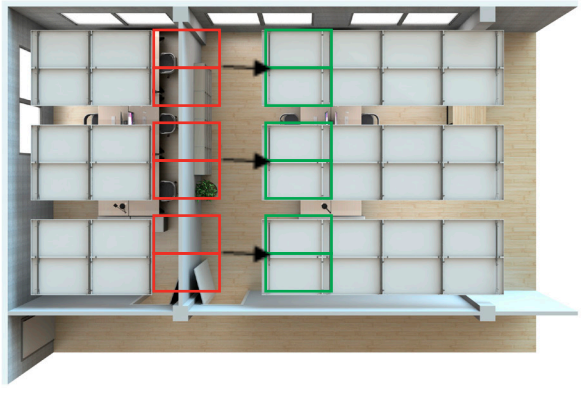
In particular – thanks to the innovative flexible bracket – the system provides the option of dismantling the ceiling panels in one room and reassembling them in another when walls are installed or removed, without the need to order new materials. All that's required is a few new drilling points.



Open-plan office without partition walls



Partition walls can be retrofitted and the ceiling panels can be moved.

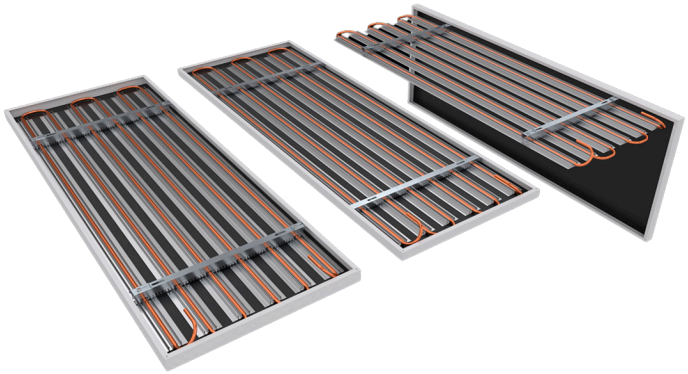


SPECTRA M – Upgrade with magnetic force

The SPECTRA M metal ceiling activation element is one of the only products on the market that uses magnetic force to create a thermally conductive yet detachable connection between the cooling coil and the ceiling panel.

This allows for unbeatable flexibility, be it

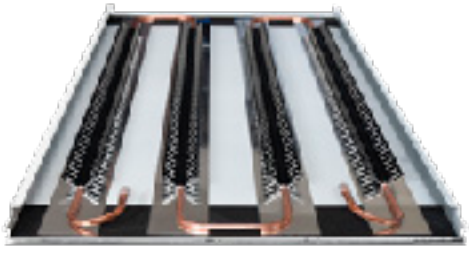
- when retrofitting existing ceilings with cooling technology:
  There's no need to order new ceiling panels – the existing panels can be converted into active radiant ceiling panels in the building in just a few simple steps.



- when replacing the old ceiling panels of an existing radiant ceiling:
  The costs and energy required for a new activation element can be saved here. In many cases (with ceiling sails), the activation element does not even need to be removed from the ceiling, a new panel is simply mounted into it.

Cooling capacity upgrade with Convector Wings

The basic version of the A11-S radiant ceiling sail already delivers a high cooling capacity. However, there may be good reason to consider installing an even greater cooling capacity:



- Very high cooling loads or much higher ones than expected occur in a corner room
- A room that has previously had low occupancy levels is converted into a meeting room with high cooling loads
- The occupancy density within a building greatly increases

In all these instances, an upgrade with Convector Wings is the ideal choice, because it increases the cooling capacity by around 16 to 20 % and can therefore negate the need to adapt the entire air conditioning system.

The Convector Wings can be quickly and easily mounted on the copper pipes of the A11 cooling coil, without the need for any tools.

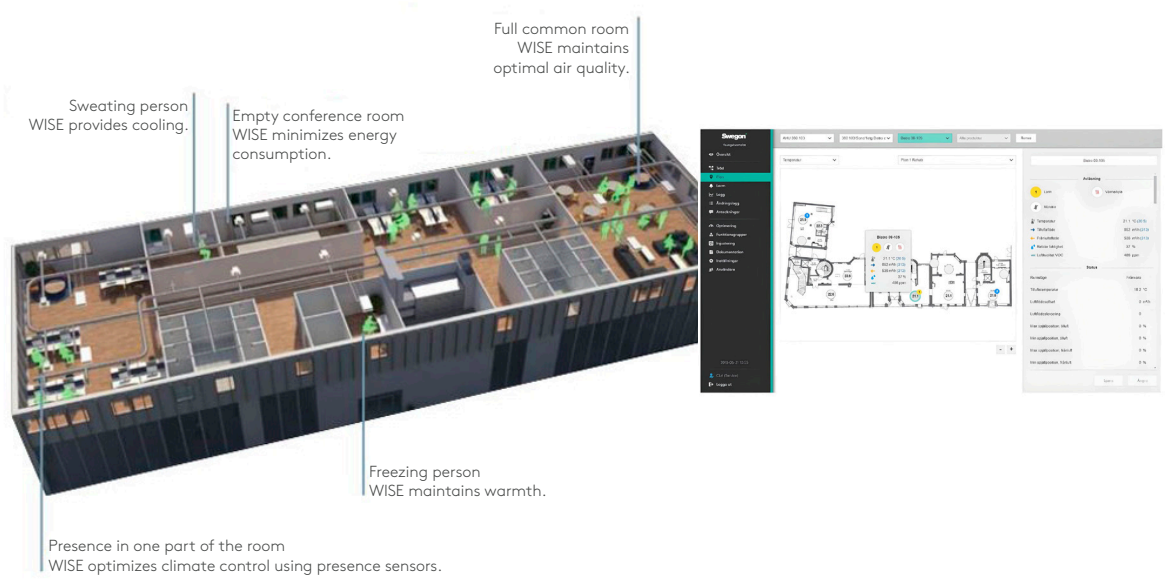
Radio-based control technology with WISE

In addition to the entire building technology from the basement to the roof, the product range from Swegon also includes WISE, a fully developed building control system that has been established for years, particularly in Scandinavia.

Alongside many other advantages – in particular the option of having the entire building technology controlled by the company that manufactured it – WISE is a radio-based system.

This brings with it the following benefits:

- **Flexibility**: The SuperWISE interface provides an overview and control of the entire system. If the system requirements change, e.g. due to the relocation of walls or modified operation within the premises, the system configuration can be adapted. Product updates are sent over the wireless network with minimal disruption to existing operations.



- **Wireless communication** minimises cable installations: Wireless communication between products significantly reduces installation time and eliminates the risk of wiring errors. Logistics throughout the entire construction process are simplified, as the products require no unique pre-settings. All that's required is the right type of product installed in the right place.

If individual sensors, actuators or similar fail within the radio network, the system regulates itself and sets up a new communication network fully automatically.

Conclusion

The versatility of radiant ceilings makes them ideal for meeting the wide range of requirements of modern office buildings.

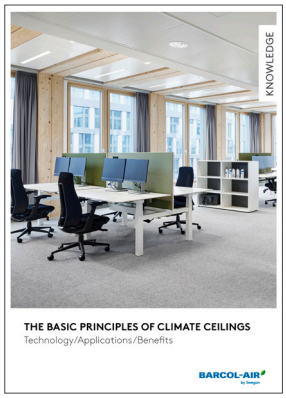
Developments in various areas of climate control technology make it possible to design ceilings as flexible systems that keep pace with changes in the building and can be adapted to new conditions in just a few simple steps.

With more than 45 years of experience in radiant ceiling systems and thermal comfort, we would be happy to support you with your radiant ceiling projects.

Notes

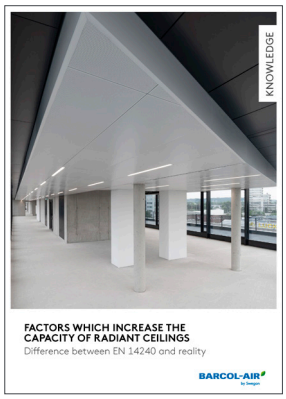
Other documents with facts and insights

The basic principles of radiant ceilings
Technology / Applications / Benefits

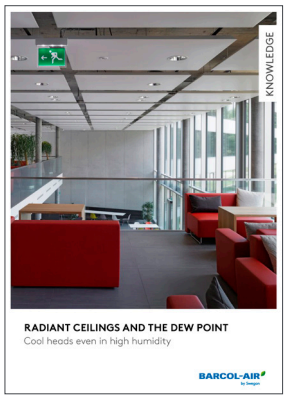


Planning room acoustics in offices
A comfort factor in focus

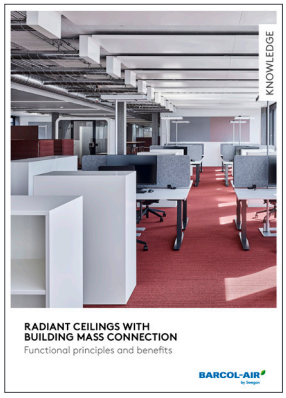
Capacity of radiant ceilings
Difference between EN 14240 and reality



Radiant ceilings and the dew point
Cool heads even in high humidity



Radiant ceilings with building mass connection
Functional principles and benefits



Energy efficient cooling
Increasing the water flow temperature

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